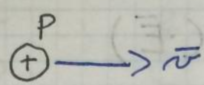
Tarea #3

21... 25, 29, 31, 43, 45

P 718
21.27)



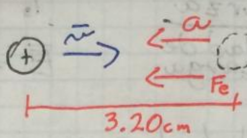
$v = 4.50 \times 10^{6}$ m/s

$m_p = 1.673 \times 10^{-27}$ Kg

$q_p = 1.6 \times 10^{-19}$ C

a) $v_f = 0$

$d = 3.20$ cm



$$v_f^2 + v_0^2 = 2a\Delta x \Rightarrow a = \frac{v_f^2 + v_0^2}{2\Delta x}$$

$$a = \frac{0 + (4.50)^2 \times 10^{+6}}{2(0.0320)} = -3.16 \times 10^{14} \Rightarrow -3.16 \times 10^{14}\ m/s^2\ (\hat{\imath})$$

$$F = ma = (1.673 \times 10^{-27})(-3.16 \times 10^{14}) = -5.29 \times 10^{-13} N(\hat{\imath})$$

$$E = \frac{F}{q} = \frac{-5.29 \times 10^{-13} N(\hat{\imath})}{1.6 \times 10^{-19} C} = -3.31 \times 10^{6} \frac{N}{C}(\hat{\imath})$$ //

b) $\Delta x = v_0 \Delta t + \frac{1}{2} a \Delta t$ | $a = \frac{\Delta v}{\Delta t}$

$\left(\frac{v + v_0}{2}\right)\Delta t = \Delta x$ → Sólo para aceleración cte.

$$\Delta t = \frac{2\Delta x}{v_0} = \frac{2(0.0320)}{4.50 \times 10^{6}} = 1.42 \times 10^{-8} s$$ //

c) $F = ma = \underbrace{(9.11 \times 10^{-31})}^{m_e}(-3.16 \times 10^{14}) = -2.88 \times 10^{-16} N(\hat{\imath})$

$$E = \frac{F}{q} = \frac{-2.88 \times 10^{-16}}{-1.6 \times 10^{-19}} = 1800 \frac{N}{C}(\hat{\imath})$$

$$\bar{F} = q\bar{E}$$

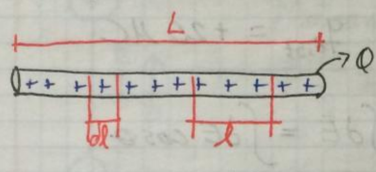
Si q (+) $\vec{F}$ misma dirección $\bar{E}$

Si q (−) $\vec{F}$ dirección opuesta $\bar{E}$

21/7/14

Cargas Uniformemente Distribuidas

1) Densidad lineal de carga λ lamda

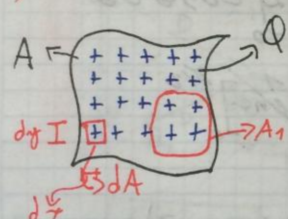


$$\lambda = \frac{\text{carga total}}{\text{Long. total}}$$

$$\lambda = \frac{Q}{L}$$

$$dq = \lambda\, dl \qquad q = \lambda l$$

2) Densidad superficial de carga σ sigma

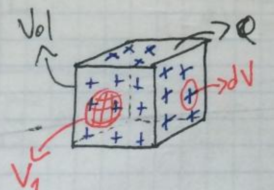


$$\sigma = \frac{Q}{A}$$

$$q = \sigma A_1$$

$$dq = \sigma\, d_x\, d_y$$

3) Densidad Volumétrica de carga ρ ro



$$\rho = \frac{Q}{Vol}$$

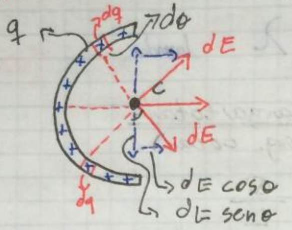
$$q = \rho V_1$$

$$dq = \rho\, dV$$

$$dq = \rho\, dx dy dz$$

$s = r\theta$ $\qquad$ $l = \pi r \rightarrow$ media circ.

Ej) Calcule el campo eléctrico en "C"



$l_{varilla} = 30\,cm$

$q_{dist} = +20\,\mu C$

$E = \int d\bar{E} = \int dE\cos\theta$

$E = \int k\frac{dq}{d^2}\cos\theta = \frac{k}{d^2}\int \lambda \overset{\text{por ser arco}}{ds}\cos\theta$ → por ser 1/4 circ

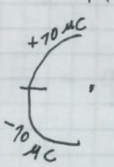
$E = \frac{k}{d^2}\lambda\int r\,\overset{\text{por ser dif de ángulo}}{d\theta}\cos\theta = \frac{K}{d^2}\lambda\int_0^{\pi/2}\cos\theta\, d\theta$

$E = \frac{2K\lambda}{r}\ \sin\theta\Big]_0^{\pi/2} = \frac{2K\frac{q}{\cancel{l}}}{\frac{\cancel{l}}{\pi}}\ \cancel{\sin\theta}\Big]_0^{\pi/2}$

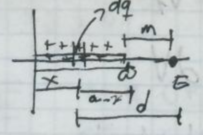
$E = \frac{2K\pi q}{l^2} = \frac{2*(9\times10^9)(\pi)(20\times10^{-6})}{(0.30)^2}$

$E = 1.26\times10^{-7}\ \frac{N}{C}\ (\hat{\imath})$

Tarea #4



21, 47, 61, 73
71



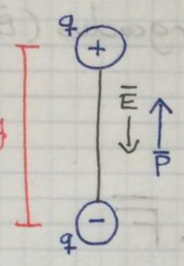
$\lambda = \frac{q}{a}$

$dE\ \ K\frac{dq}{d^2} \Rightarrow E = \int dE$

$E = K\int_0^a \frac{\lambda\, dx}{(a+m-x)^2}$

23/7/14

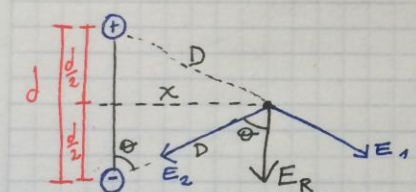
Dipolo Eléctrico



Momento dipolar

$\bar{P} = q\,d$ Hacia la carga positiva

Campo eléctrico debido a un dipolo



$E_R = 2\overset{\to \text{ó } E_2}{E_1} \cos\theta$

$E_R = 2\,K\dfrac{q}{r^2}\,\cos\theta$

$E_R = 2\,K\left(\dfrac{q}{D^2}\right)(\cos\theta)$

$D = \sqrt{\left(\frac{d}{2}\right)^2 + x^2}$

$$E = \cancel{2}\,K\left(\frac{q}{\left(\frac{d}{2}\right)^2 + x^2}\right)\left(\frac{\frac{d}{\cancel{2}}}{\sqrt{\left(\frac{d}{2}\right)^2 + x^2}}\right) = K\,\frac{q\,d}{\left(\left(\frac{d}{2}\right)^2 + x^2\right)^{3/2}}$$

$$\boxed{E = K\,\frac{P}{\left[\left(\frac{d}{2}\right)^2 + x^2\right]^{3/2}}}$$

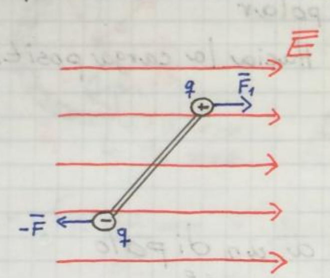
$\rightarrow \bar{E}$ en direccion $-\bar{P}$

Para $x >> d$ $\quad E = K\,\dfrac{P}{x^3}$

Tarea 5: 21... 57, 59, 69, 75

Un dipolo dentro de un campo eléctrico constante:

- Lo produce una o mas placas cargadas ($\bar{E}$)



$$\bar{F} = q\bar{E}$$

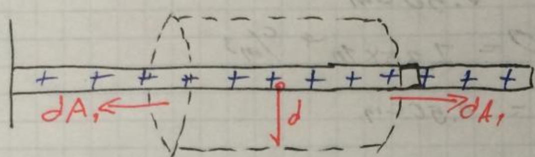
Torque:

$$\bar{\tau} = \bar{r} \times \bar{F}$$

1/8/14

Aplicacionesde la Ley de Gauss

22.18



$d = 0.100\ m$

$E = 84\ N/C$

$q = ?$

$l = 20\ cm$

$$\oint E \cdot dA = \frac{q_{NE}}{\varepsilon_0}$$

$$\int E\,dA \cos 0° = \frac{\lambda L}{\varepsilon_0} \Rightarrow E\int dA = \frac{\lambda L}{\varepsilon_0}$$

$$E = \frac{\lambda}{\varepsilon_0 (2\pi d)} \Rightarrow \lambda = E\, 2\pi \varepsilon_0 d$$

$$\lambda = \frac{q}{l} \Rightarrow q = \lambda l \Rightarrow q = E\, 2\pi \varepsilon_0 d l$$

$$q = 840 \times 2\pi (8.85\times 10^{-12})(0.400)(0.02)$$

$$q = 3.74\times 10^{-10}\ C$$

22... 15, 17, 19, $\underbrace{1, 2, 3, 5}_{\text{Preg}}$

22.22)

$q = -200\,\mu C$

$r = 6.50\,cm$

$\rho = 7.35 \times 10^{-4}\ C/m^3$

$d = 9.50\,cm$

$\oint E \cdot dA = \frac{q_{NE}}{\varepsilon_0} \Rightarrow \oint E\,dA \cos 0° = \frac{q_{NE}}{\varepsilon_0}$

$E \int dA = \frac{q_{NE}}{\varepsilon_0} \Rightarrow E(4\pi d^2) = \frac{q_{NE}}{\varepsilon_0}$

$q_{NE} = -2.00 \times 10^{-6} + \rho\, vol$

$q_{NE} = -2.00 \times 10^{-6} + \rho\left(\frac{4}{3}\pi(d^3 - r^3)\right)$

$q_{NE} = -2.00 \times 10^{-6} + 7.25 \times 10^{-4}\left(\frac{4}{3}\pi\,(0.0095^3 - 0.0065^3)\right)$

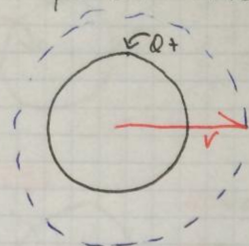
$q_{NE} = -0.206\,\mu C$

$E(4\pi d^2) = \frac{q_{NE}}{\varepsilon_0} \Rightarrow E = \frac{1}{4\pi\varepsilon_0}\,\frac{q_{NE}}{d^2}$

$E = 9 \times 10^9 \times \frac{0.206 \times 10^{-6}}{(0.0950)} = 2.05 \times 10^5\ N/C$

4/7/14

Campo Eléctrico debido a una esfera cargada



$E = ?$ $\oint E\, dA = \frac{q_{NE}}{\varepsilon_0}$

$\oint E\, dA \cos 0° = \frac{Q}{\varepsilon_0}$

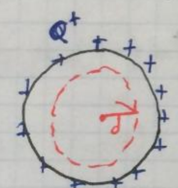
Afuera no importa si es o no es conductora

$E \oint dA = \frac{q}{\varepsilon_0} \Rightarrow EA = \frac{Q}{\varepsilon_0} \Rightarrow E\, 4\pi r^2 = \frac{Q}{\varepsilon_0}$

$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2} \Rightarrow E = K\frac{Q}{r^2}$

Dentro de la esfera

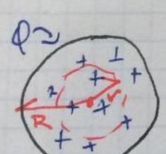
1) Esfera conductora



$\oint E\, dA = \frac{q_{NE}}{\varepsilon_0} \Rightarrow \oint E\, dA \cos 0° = \frac{0}{\varepsilon_0}$

$E \oint dA = 0 \Rightarrow E = 0$

2) No conductora



$\rho = \frac{Q}{Vol} \Rightarrow \rho = \frac{Q}{\frac{4}{3}\pi R^3}$

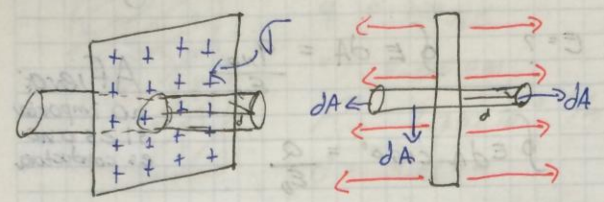
$\oint E\, dA = \frac{q_{NE}}{\varepsilon_0} \Rightarrow \oint E\, dA = \frac{q_{NE}}{\varepsilon_0}$

$E \oint dA = \frac{\rho\, Vol_1}{\varepsilon_0} \Rightarrow E\, 4\pi r^2 = \frac{\frac{Q}{\frac{4}{3}\pi R^3} \times \frac{4}{3}\pi r^3}{\varepsilon_0}$

$E = \frac{1}{4\pi\varepsilon_0} \times \frac{Q r}{R^3}$

22... 21, 23, 25, 27, 47

Campo eléctrico debido a una placa no conductora

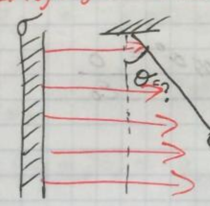


$$\oint E \cdot dA = \frac{q_{NE}}{\varepsilon_0} \Rightarrow \int E\, dA_1 + \int E\, dA_2 = \frac{q_{NE}}{\varepsilon_0}$$

$$A_1 E + A_2 E = \frac{\sigma A}{\varepsilon_0} \Rightarrow AE + AE = \frac{\sigma A}{\varepsilon_0}$$

$$2E = \frac{\sigma}{\varepsilon_0} \Rightarrow E = \frac{\sigma}{2\varepsilon_0}$$

22.43) Figura en libro modelo

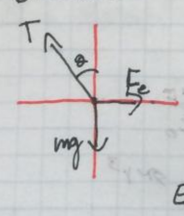


$\sigma = 2.50 \times 10^{-9} \frac{C}{N \cdot m^2}$

$q = 5.00 \times 10^{-1}\ C$

$m = 4.00 \times 10^{-6}\ kg$

D.C.L.



$\Sigma F_y = 0 \Rightarrow T_y = mg$

$T\cos\theta = mg \Rightarrow T = \frac{mg}{\cos\theta}$

$\Sigma F_x = 0 \Rightarrow Fe = T_x$

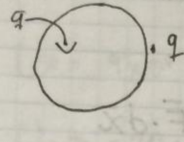
$Eq = T \operatorname{sen}\theta \Rightarrow \frac{\sigma}{2\varepsilon_0} q = \frac{mg}{\cos\theta} \operatorname{sen}\theta$

$$\frac{\sigma q}{2\varepsilon_0 m g} = \tan\theta \Rightarrow \tan\theta = \frac{(2.50 \times 10^{-9})(5 \times 10^{-1})}{2(8.85 \times 10^{-12})(4 \times 10^{-6})(9.8)} \Rightarrow \theta = 10.21° \;//$$

22..., 33, 35, 45, 49, 51 / 11, 12, 13 Preg

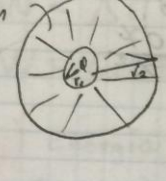
22.27)

$w = \int F\, dx$



$\int_r^{\infty} F\,dx = \int_r^{\infty} Eq\, dx = \int_r^{\infty} \frac{K q_1 q_2}{x^2} = K q_1 q_2 \int_r^{\infty} \frac{dx}{x^2}$

22.28)



a) sup interior del conductor

b) sup ext. del conductor

$q_1 = 5\mu C$

$q_2 = -6\mu C$

$r_1 = 5$ cm

$r_2 = 10$ cm

$E = ?$ $d_1 = 3$ cm

$E ?$ $d_2 = 8$ cm

$E ?$ $d_3 = 15$ cm

$\oint E\,dA = \frac{q_{NE}}{\varepsilon_0}$

$\oint E\,dA \cos 180 = \frac{q_2}{\varepsilon_0} \Rightarrow E \int dA = \frac{q_2}{\varepsilon_0}$

$E(4\pi d_1^2) = \frac{q_2}{\varepsilon_0} \Rightarrow E = \frac{1}{4\pi\varepsilon_0} \frac{q_2}{d_2^2}$

$E = (9\times10^9)\frac{(6\times10^{9})}{(0.03)^2} = 60{,}000$ N/C

$d = 8$ cm

$\oint E \cdot dA = \frac{q_{NE}}{\varepsilon_0} \Rightarrow \oint E A \cos 0 = \frac{0}{\varepsilon_0} \Rightarrow E = 0$

$d = 15$ cm

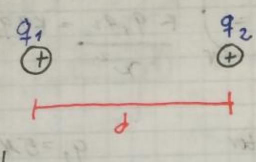
$\oint E A \cos 180 = \frac{q_1 + q_2}{\varepsilon_0} \Rightarrow \oint E\,dA = \frac{1\times10^{-9}}{\varepsilon_0}$

$E = 9\times10^9 * \frac{1\times10^{-9}}{(0.15)^2} = 400$ N/C

Si sólo hay una carga no hay trabajo

8/8/14

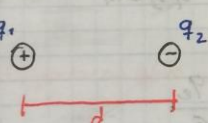
Energía Potencial Eléctrica



$$U = W = \int dw = \int \bar{F}\cdot d\bar{x}$$

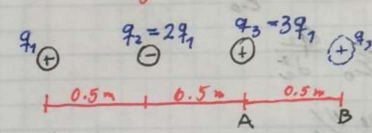
$$= \int_{\infty}^{d} F\, dx \cos 0^\circ = \int K \frac{q_1 q_2}{x^2} dx = K q_1 q_2 \int_{\infty}^{d} \frac{dx}{x^2}$$

$$\boxed{U = K\frac{q_1 q_2}{d}}$$



Trabajo negativo

W para mover q_3 de A a B



$q_1 = 12\,\mu C$

$$U_0 = K\frac{q_1 q_2}{d_{12}} + K\frac{q_3 q_1}{d_{13}} + K\frac{q_2 q_3}{d_{23}}$$

$$U_0 = K\left[\left(-\frac{2q_1^2}{0.50}\right) + \frac{3q_1^2}{1.00} - \frac{6q_1^2}{0.50}\right] = (9\times10^9)\left[(12\times10^{-6})^2\left(\frac{-2}{0.5} + \frac{3}{1} - \frac{6}{0.5}\right)\right]$$

$$U_0 = -16.85\ J$$

P1 24 Agosto   Resumen cap 23

en B

$$U_F = K\left(\frac{-2q_1^2}{0.5} + \frac{3q_1^2}{1.50} - \frac{6q_1^2}{1}\right)$$

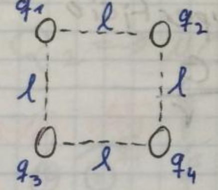
$$U_F = 9\times10^{9} \times (12\times10^{-6})^2 \left[-\frac{2}{0.5}+\frac{3}{1.5}-\frac{6}{1}\right]$$

$$U_F = -10.37\ J$$

$$W = \Delta U = U_F - U_0 = -10.37 - (-16.85)$$

$$W = 6.48\ J$$

Ej) Energía en sistema



$$U = K\frac{q_1q_2}{\ell} + K\frac{q_1q_3}{\ell} + K\frac{q_2q_3}{\sqrt{2}\ell} + K\frac{q_1q_4}{\sqrt{2}\ell} + K\frac{q_2q_4}{\ell} + K\frac{q_3q_4}{\ell}$$

$F = K\dfrac{q_1q_2}{d^2}$ $E = \dfrac{F}{q_0}$ Vectores $E = K\dfrac{q}{d^2}$

$U = K\dfrac{q_1q_2}{d}$ $V = \dfrac{U}{q_0}$ Escalares $V = K\dfrac{q}{d}$

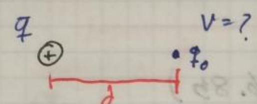
Los é buscan regiones de alto potencial

Campo $\vec{E}$ dentro $O_{cond} = \emptyset$

11/8/14

Potencial Eléctrico (V)

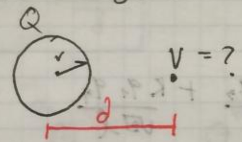
$$V = \frac{U}{q_0} = \frac{[J]}{[C]} = \text{Volt}$$



$$V = \frac{U}{q_0} \Rightarrow V = \frac{\frac{K q q_0}{d}}{q_0}$$

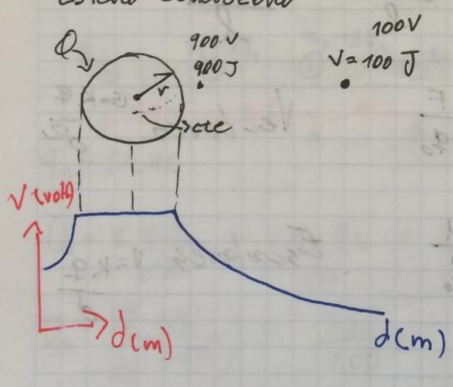
$$\boxed{V = K\frac{q}{d}}$$

Esfera Cargada:



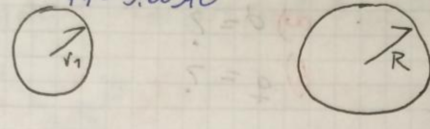
$V = K\frac{q}{d}$ En la superficie $V = K\frac{Q}{r}$

Esfera Conductora



23... 1, 3, 5, 11, 15

$q_1 = 5.00\mu C$ $\qquad$ $q_2 = -10.0\mu C$



$r = 20cm$ $\qquad$ $V_1 = V_2$

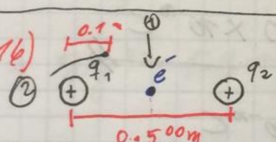
$R = 30cm$ $\qquad$ $\cancel{K}\dfrac{q_1}{r} = \cancel{K}\dfrac{q_2}{r} \Rightarrow Q_1 = \dfrac{r}{R} Q_2$

$Q_1 + Q_2 = -5\mu C$ $\qquad$ $Q_1 = \dfrac{20}{30} Q_2 \Rightarrow Q_1 = \dfrac{2}{3} Q_2$

$\dfrac{\cancel{2}}{3} Q_2 + Q_2 = -5\mu C \Rightarrow Q_2 = \dfrac{3}{5}(5\mu C)$

$Q_2 = -3\mu C$ $\qquad$ $Q_1 = -2\mu C$

23.16)



$q_1 = 3.00nC$ $\qquad$ $V = \dfrac{U}{q}$

$q_2 = 2.00nC$ $\qquad$ $\Delta V = \dfrac{\Delta U}{q}$

$V_1 = K\dfrac{q_1}{d_1} + K\dfrac{q_2}{d_2}$ $\qquad$ $q\Delta V = \Delta U$

$V_1 = (9\times10^9)\left(\dfrac{3\times10^{-9}}{0.25}\right) + (9\times10^9)\left(\dfrac{2\times10^{-9}}{0.25}\right) = 180V$

$V_2 = K\dfrac{q_1}{d_1'} + K\dfrac{q_2}{d_2'}$

$V_2 = (9\times10^9)\left(\dfrac{3\times10^{-9}}{0.1}\right) + (9\times10^9)\left(\dfrac{2\times10^{-9}}{0.40}\right) = 315V$

$\Delta V q = \Delta U \Rightarrow (V_2 - V_1)q = K_f - \cancel{K_0}^{\,0} \Rightarrow \dfrac{1}{2} m v_2^2 = (315-180)(1.6\times10^{-19})$

cambio de energia

$v_2 = \sqrt{\dfrac{2(315-180)(1.6\times10^{-19})}{9.11\times10^{-31}}} = 6.89\times10^6\ m/s$

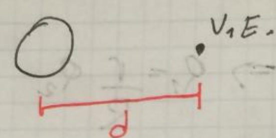
23.24)

$V = 4.98\,V$

$E = 12.0\,\frac{V}{m} = 12.0\,\frac{N}{C}$

a) $d = ?$

b) $q = ?$



$V = K\frac{q}{d} = 4.98$

$E = K\frac{q}{d^2} = K\frac{q}{d} * \frac{1}{d} = 12.0$

$4.98 * \frac{1}{d} = 12 \Rightarrow d = \frac{4.98}{12} = 0.415\,m$

$E = \frac{V}{d} \Rightarrow V = Ed$

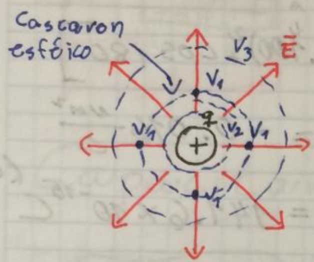
$q = \frac{Vd}{K} = \frac{4.98 \times 0.415}{9 \times 10^9} = 2.30 \times 10^{-10}\,C$

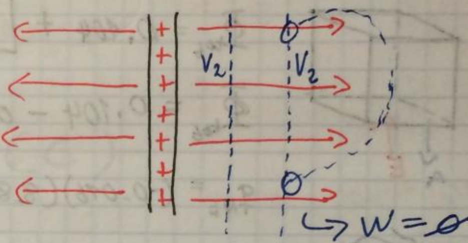
$q = \frac{Ed^2}{K} = \frac{12(0.415)^2}{9 \times 10^9} = 2.30 \times 10^{-10}\,C$

Líneas equipotenciales siempre son perpendiculares a las líneas de campo

18/8/14

Líneas Equipotenciales





P6, T11)

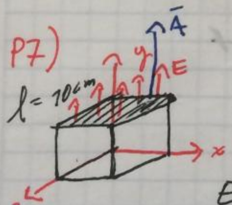
$$E_s = -\frac{dV}{ds} \Rightarrow E_x = -\frac{dV}{dx} \text{ ó } E_y = -\frac{dV}{dy}$$

$V = 8y^2 - 12y + 25$ en $(2,3,4)$

$$E_y = -16y + 12$$

$$E_{(3)} = \left(-16(3) + 12\right)\bar{y} = -36 \frac{N}{C} \hat{j} \quad (c)$$

P7)



$$\Phi = E \cdot A$$

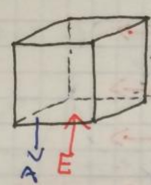
$$\Phi_{(0.10)} = E \cdot A \cos 0°$$

$$E_{(0.10)} = -16(0.10) + 12 = 10.4\ N/c$$

$$\Phi = (10.4)(0.10)^2(1) = 0.104 \frac{Nm^2}{c} \quad (a)$$

Tarea T11

P8) $\oint \bar{E} \cdot d\bar{A} = \frac{q_{NE}}{\varepsilon_0} \Rightarrow q_{NE} = \Phi_{Tot}\, \varepsilon_0$

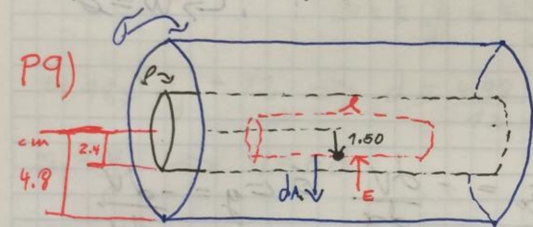


$\Phi_{tot} = 0.104 + \left[\overset{E}{11} * (0.\overset{A}{100})^2 * \cos 180\right]$

$\Phi_{tot} = 0.104 - 0.120 = -0.016 \frac{Nm^2}{C}$

$q_{NE} = (-0.016)(8.85 \times 10^{-12}) = 141.6 \times 10^{-15} C$ (d)

P9)



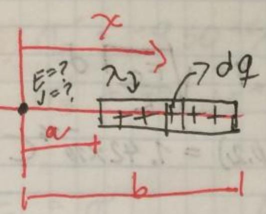
$\rho = -1.50 \times 10^{-5}\ C/m^3$

$\sigma = +3.50 \times 10^{-6}\ C/m^2$

$\oint \bar{E}\, d\bar{A} = \frac{q_{NE}}{\varepsilon_0} \Rightarrow E \int dA_1 = \frac{\rho\, Vol_1}{\varepsilon_0}$

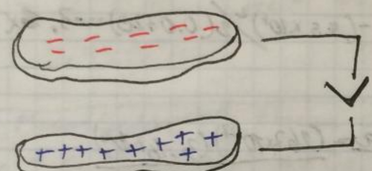
$E(2\cancel{\pi}\cancel{d}\cancel{l}) = \frac{\rho \cancel{\pi} d^{\cancel{2}} \cancel{l}}{\varepsilon_0} \Rightarrow E = \frac{\rho d}{2\varepsilon_0}$

$E = \frac{1.50 \times 10^{-6} \times 0.0150}{2(8.85 \times 10^{-12})} = 12,712\ \frac{N}{C}$



$$E = K\int \frac{dq}{r^2} = K\int_a^b \frac{\lambda}{x^2}\,dx = K\lambda\int_a^b \frac{dx}{x^2}$$

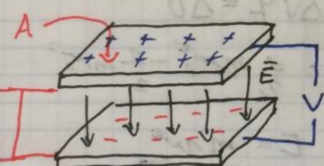
Capacitancia (C)



$$C = \frac{q}{V}$$

$$[C] = \frac{[C]}{[V]} = \text{Farad} \quad [F]$$

Capacitores de Placas Planas Paralelas

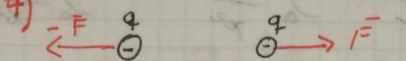


$$C = \frac{q}{V} \Rightarrow C = \frac{q}{Ed} \Rightarrow C = \frac{q}{\frac{\sigma}{\varepsilon_0}d}$$

$$C = \frac{\varepsilon_0 \, q}{\frac{q}{A}\, d} \Rightarrow \boxed{C = \varepsilon_0 \frac{A}{d}}$$

HP1

4)



$F_c = k\frac{q^2}{d^2} \Rightarrow q = \sqrt{\frac{F_c}{k}}\, d$

$q = \sqrt{\frac{4.57\times10^{-21}}{9\times10^{9}}}\,(0.2) = 1.42\times10^{-16}\,C$

$\#e^- = \frac{1.42\times10^{-16}}{1.6\times10^{-19}} = 890.73 \approx \underline{891}$

5) $v_0 = 4.50\times10^{6}\ \hat{\imath}\ m/s$

$\Delta x = 3.20\ cm$

$v_f = 0$

$\cancel{v^2}^{0} - v_0^2 = 2a\Delta x$

$a = -(4.5\times10^{6})^2/2(0.0320) = -3.16\times10^{14}\ m/s^2$

$F = ma \Rightarrow qE = ma \Rightarrow E = \frac{ma}{q} = \frac{(1.67\times10^{-27})(3.16\times10^{14})}{1.6\times10^{-19}}$

$E = 3.3\times10^{6}\ N/C$

6) $\left(\frac{v_0 + \cancel{v_F}^{0}}{2}\right)\Delta t = \Delta x$

$\frac{v_0}{2}\Delta t = \Delta x \Rightarrow \Delta t = \frac{2\Delta x}{v_0}$

$t = 14.2\times10^{-9}\,s$

$V = \frac{U}{q} \Rightarrow \Delta V q = \Delta U$

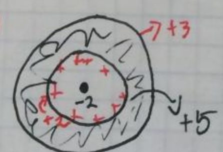
$E\,dq = \frac{1}{2}m\cancel{v_f^2} - \frac{1}{2}m v_0^2$

$E = \frac{m v_0^2}{2qd}$

11) $\Phi \Rightarrow q_{NE}$

↳ q permanece igual ∴ Φ igual

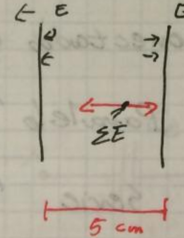
15)



$U = -\bar{P} \cdot E$ ← En dipolo

16) $\sigma_A = -9.50\ \mu C/m^2$

$\sigma_B = -11.60\ \mu C/m^2$



$E = \dfrac{\sigma}{\varepsilon_0}$ $\qquad$ $E = \dfrac{\sigma}{2\varepsilon_0}$

$E_1 = 1.07\times10^6$ $\qquad$ $E_1 = 5.37\times10^5$

$E_2 = 1.31\times10^6$ $\qquad$ $E_2 = 6.55\times10^5$

$2.4\times10^5\ (2)$ $\qquad$ $1.19\times10^5\ (2)$

Cap. Placas Paralelas

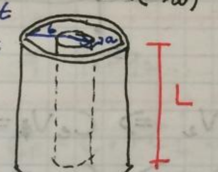
$C = \varepsilon_0 \dfrac{A}{d}$

Cap. Placas cilíndricas

$C = 2\pi\varepsilon_0 \dfrac{L}{\ln(b/a)}$

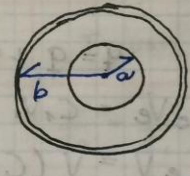
$b = r_{ext}$

$a = r_{int}$



Cap. Placas Esféricas 25/8/14

$C = 4\pi\varepsilon_0 \dfrac{ab}{b-a}$

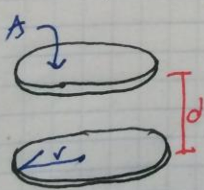


24.6)

$C = 10.0\ \mu F$ $\qquad$ a) 12 V

$V = 12.0\ V$ $\qquad$ b) i) d se duplica $V = ?$ $\quad$ ii) r se duplica $V = ?$

$C = \dfrac{q}{V} \Rightarrow V = \dfrac{q}{C}$ $\qquad$ i) $V = \dfrac{q}{c} \Rightarrow V' = \dfrac{q}{c/2} \Rightarrow V' = 2\dfrac{q}{C}$



$V' = 2(V) = 2(12) = 24V$

ii) $C = \dfrac{q}{V} \Rightarrow V = \dfrac{q}{C} \Rightarrow V_1 = \dfrac{q}{4C}$

$A = \pi r^2$

$A_1 = \pi(2r)^2$

$A_1 = \pi 4 r^2$

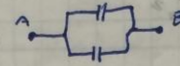
$A_1 = 4\pi r^2$

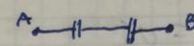
$A_1 = 4A$

$V_1 = \dfrac{1}{4}\left(\dfrac{q}{C}\right) = \dfrac{1}{4}V = \dfrac{1}{4}(12) = 3V$

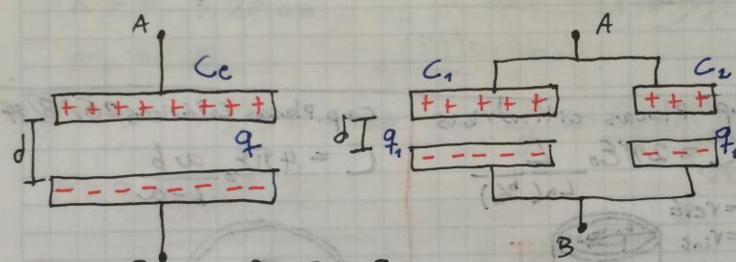
Tarea 24... 1, 3, 5, 7, 9

Capacitores conectados entre sí:

Conexión en Paralelo 

Conexión en Serie 

Capacitores en Paralelo:



En Paralelo Dif de Pot va a ser la misma

$$q = q_1 + q_2$$

$$C_e V_e = C_1 V_1 + C_2 V_2 \Rightarrow C_e V = C_1 V + C_2 V$$

$$C_e V = V(C_1 + C_2) \Rightarrow C_e = C_1 + C_2$$

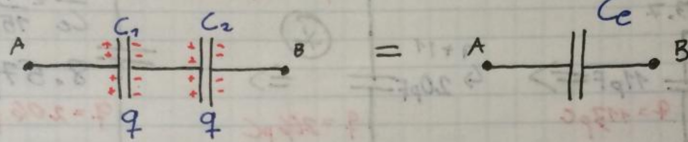
$$ó \quad C_e = \sum_{i=1}^{n} C_i$$

$$q = q_1 + q_2 + \dots q_n$$

$$C_e = C_1 + C_2 \dots C_n$$

$$V = V_1 = V_2 = V_n$$

Capacitores en Serie:



$$V = V_1 + V_2$$

$$\frac{q}{C_e} = \frac{q}{C_1} + \frac{q}{C_2} \Rightarrow \frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} \quad ó \quad \frac{1}{C_e} = \sum_{i=1}^{n} \frac{1}{C_i}$$

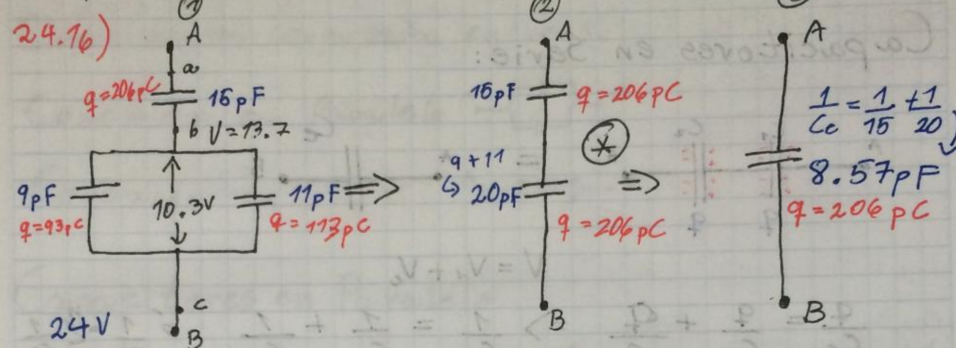
	En Paralelo	En Serie
Carga	$q = q_1 + q_2 \ldots$	Igual
Capacitancia	$C_e = C_1 + C_2 \ldots + C_n$	$\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} \cdots \frac{1}{C_n}$
Dif. Potencial	$V_1 = V_2 = V_n$	$V = V_1 + V_2 + \ldots$

En paralelo C_e tiene que ser mayor que C_{mayor}

En serie C_e tiene que ser menor que C_{menor}

En paralelo   24... 17, 19, 21

24.16)



③ $C=\frac{q}{V}=q=CV \Rightarrow q_e=C_eV=(8.57\times10^{-12})(24)=206\,pC$

(*) para comprobar $\Sigma=24$ en este caso

② $=\left(\frac{\quad}{\quad}\right)\times10^{-12}+\left(\frac{206}{20}\right)\times10^{-12}=24.0\,V$

$V_1=13.7 \quad + \quad V_2=10.3\,V \quad =24\,V$

① $q=CV$

$q_1=CV=11\times10^{-12} * 10.3\,V=113\,pC$

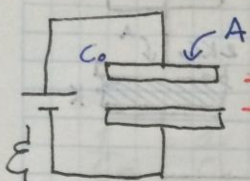
$q_2=CV=9\times10^{-12} * 10.3\,V=92.7\,pC \approx 93\,pC$

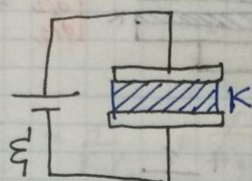
comprobando $q_e=q_1+q_2=113+93=206\,pC$ ✓

1/9/14

Capacitores con dieléctricos

1) Con fuente conectada





Cuando está conectada aumenta K veces

$$q_0 = C_0 V$$

$$C_0 = \varepsilon_0 \frac{A}{d}$$

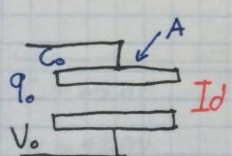
$$q = CV = K C_0 V$$

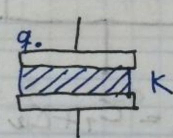
$$q = K q_0$$

$$C = K \varepsilon_0 \frac{A}{d}$$

$$C = K C_0$$

2) Con fuente desconectada





Desconectada se reduce K veces

$$C = \frac{q_0}{V_0}$$

$$V = \frac{q_0}{C_0}$$

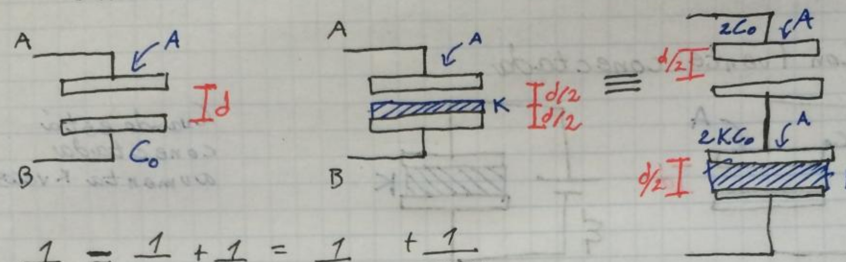
$$C = K C_0$$

$$V = \frac{q_0}{C}$$

$$V = \frac{q_0}{K C_0} = \frac{1}{K} \frac{q_0}{C_0} = \frac{1}{K} V_0$$

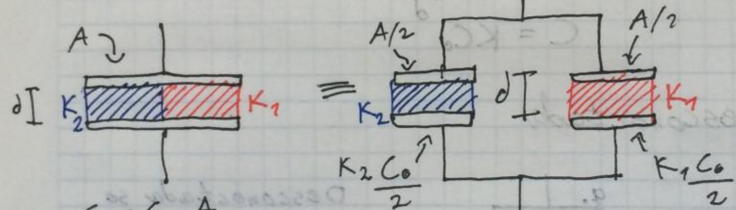
$$V = \frac{V_0}{K}$$

Llenado Parcial



$$\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{2C_0} + \frac{1}{2KC_0}$$

$$\frac{1}{C_e} = \frac{K+1}{2KC_0} \Rightarrow C_e = \frac{2KC_0}{K+1} = \frac{2K}{K+1}\, C_0$$



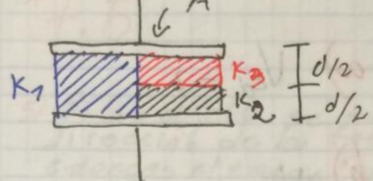
$$C_0 = \varepsilon_0 \frac{A}{d}$$

$$C_e = C_1 + C_2$$

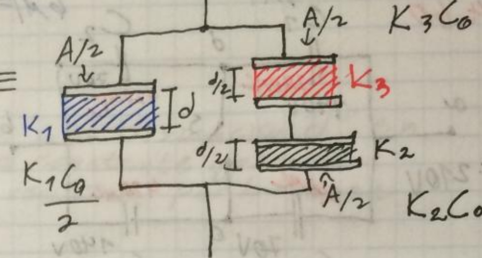
$$C_e = \frac{K_1 C_0}{2} + \frac{K_2 C_0}{2}$$

$$C_e = \frac{C_0}{2}(K_1 + K_2)$$

$$C_e = \left(\frac{K_1 + K_2}{2}\right) C_0$$



$\equiv$



$$\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{K_2 C_0} + \frac{1}{K_3 C_0}$$

$$\frac{1}{C_e} = \frac{K_3 + K_2}{K_3 K_2 C_0} \Rightarrow C_e = \left(\frac{K_2 K_3}{K_2 + K_3}\right) C_0$$

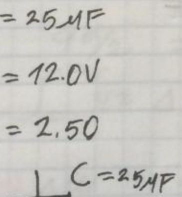
$$C_e = C_1 + C_2 \qquad C = \varepsilon_0 \frac{A/2}{d/2} = \varepsilon_0 \frac{A}{d}$$

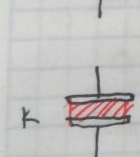
$$C_e = \frac{K_1 C_0}{2} + \frac{K_2 K_3}{K_2 + K_3} C_0 \Rightarrow C_e = C_0 \left(\frac{K_1}{2} + \frac{K_2 K_3}{K_2 + K_3}\right)$$

$C = 25 \mu F$

$V = 12.0 V$

$K = 2.50$





$$C = \frac{q}{V} \Rightarrow q = CV$$

$$q = (25 \times 10^{-6})(12) = 300 \mu C$$

$$U_0 = \frac{q^2}{2C_0} = \frac{(300 \times 10^{-6})^2}{2(25 \times 10^{-6})} = 1.80 \, mJ$$

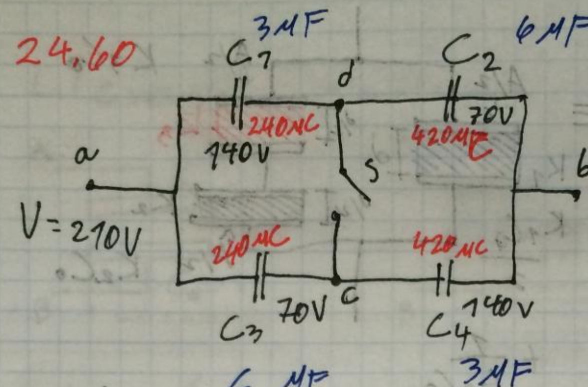
$$U_F = \frac{q^2}{2C_0} = U_F = 0.720 \, mJ$$

$$W = \Delta U \Rightarrow U_F - U_0$$

$$W = (0.720 \times 10^{-3}) - (1.80 \times 10^{-3})$$

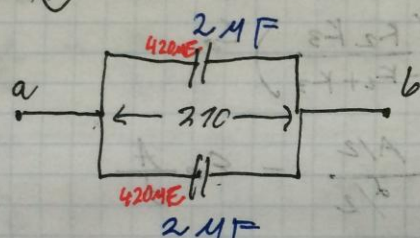
$$W = -1.08 \times 10^{-3} \, J$$

24.60



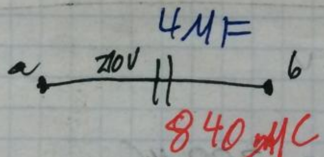
a) $V_{cd} = ?$

b) $V_{c/cap}$ con S. cerrado



$$\frac{1}{C_e} = \frac{1}{3} + \frac{1}{6}$$

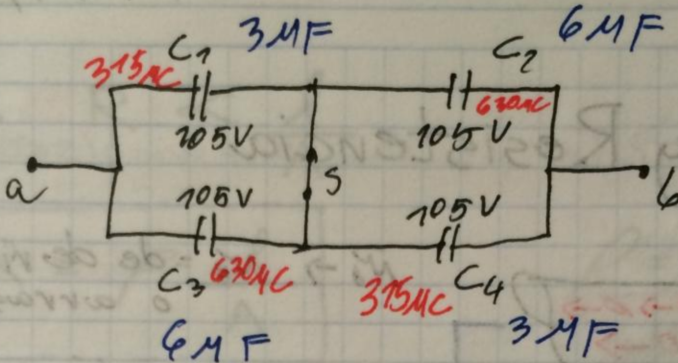
$$V_1 = \frac{q_1}{C_1} = \frac{420\,\mu C}{3\,\mu F}$$



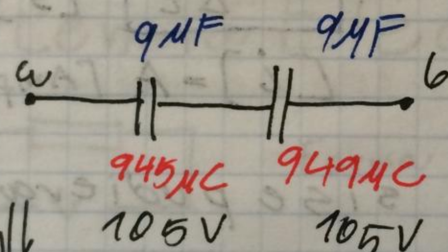
$$V_{cc} = V_c - V_d = 70 - 140 = -70V$$

24... 61, 59, 63, 65

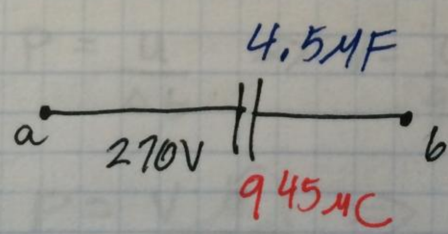
b)



⇓



⇓



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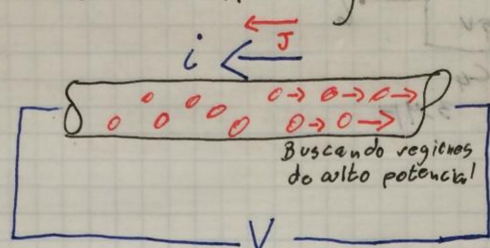
Corriente y Resistencia



$\bar{v}_d \to v_d$ = de derive o arrastre

corriente eléctrica

$\boxed{i = \frac{\Delta q}{\Delta t}}$ $\frac{[C]}{[s]}$

$[i] = A$ [Amperio]

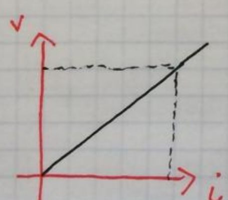
La corriente va adonde se moverían las cargas positivas si se pudieran mover. (En contra de electrones)

- Densidad de corriente (J)

$$J = \frac{i}{A} \quad \frac{[Amp]}{[m^2]}$$

$$\bar{J} = n\, q\, \bar{v}_d$$

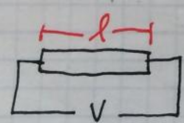
n = No. electrones libres
q = carga
$\bar{v}_d$ = velocidad de arrastre



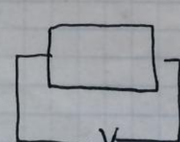
(R)

La pendiente es la resistencia eléctrica del material

$$R = \frac{V}{i} \quad \frac{[V]}{[Amp]} \Rightarrow [ohm] \Rightarrow \Omega$$



$R \propto l$



$R \propto \frac{1}{A}$

Resumen cap 25

$\therefore \quad R \propto \frac{l}{A}$

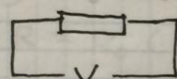
$$\boxed{R = \rho \frac{l}{A}}$$

ρ = Resistividad material

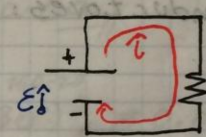
Tabla 25.1 P.823

Potencia Eléctrica

8/9/14



Forma técnica $\Rightarrow$



$$P = \frac{U}{\Delta t} \Rightarrow V = \frac{U}{q} \Rightarrow U = Vq$$

$$P = V\frac{q}{\Delta t} \Rightarrow \boxed{P = Vi}$$

$$R = \frac{V}{i} \Rightarrow V = iR \Rightarrow i = \frac{V}{R}$$

$$P = Vi \Rightarrow P = (iR)\,i$$

$$\boxed{P = i^2 R}$$

$$P = Vi \Rightarrow P = V\left(\frac{V}{R}\right) \Rightarrow \boxed{P = \frac{V^2}{R}}$$

ej) Luces en clase $\qquad P = Vi$

$P = 1{,}600\ W \qquad i = \frac{P}{V} = \frac{1{,}600\ W}{110\ V} = 14.5\ A$

$\Delta\rho = \rho_0 \alpha (T - T_0) \rightarrow T_0 = 20°C$ · Temp ambiente

$\rho - \rho_0 = \rho_0 \alpha (T - T_0)$

$$\boxed{\rho = \rho_0 (1 + \alpha \Delta T)}$$

$$\rho \frac{L}{A} = \rho_0 \frac{L}{A} (1 + \alpha \Delta T) \Rightarrow \boxed{R = R_0 (1 + \alpha \Delta T)}$$

Superconductores: materiales a temp muy baja

25.4)

Cobre $\rho = 1.72 \times 10^{-8}\ \Omega \cdot m$ a) $i = ?$

$\phi = 1.02\ mm$ b) $v_d = ?$

$J = 1.50 \times 10^6 \frac{A}{m^2}$

$n = 8.50 \times 10^{28}$

$\frac{\pi D^2}{4} = \frac{\pi R^2}{2}$

$$J = \frac{i}{A} \Rightarrow i = JA = \left(1.50 \times 10^6 \frac{A}{m^2}\right)\left(\frac{\pi (1.02 \times 10^{-3} m)^2}{4}\right)$$

$i = 1.22\ A$

$$J = n q v_d \Rightarrow v_d = \frac{J}{nq} = \frac{1.50 \times 10^6}{(8.50 \times 10^{28})(1.6 \times 10^{-19})}$$

$v_d = 0.110\ mm/s$

25... 1, 3, 5, 11, 13

25.14)

$L = 6.50\,m$ a) $\rho = ?$ (material)

$\phi = 2.05\,mm$ b) $R = ?$ a $150°C$

$R = 0.0290\,\Omega$

$$R = \rho \frac{L}{A} \Rightarrow \rho = R\frac{A}{L} = (0.0290)\frac{(\pi(0.00205)^2)}{4(6.50)}$$

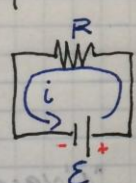
$$\rho = 1.47 \times 10^{-8}\,\Omega\,m \Rightarrow \text{Plata}$$

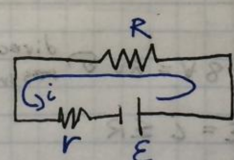
$$R = R_0(1 + \alpha\,\Delta T)$$

$\Delta T = 150 - 20$

$$R = 0.0290\,\Omega\,(1 + 0.0038\,(130°)) = 0.043\,\Omega$$

Aparatos de Medición





$V = iR$

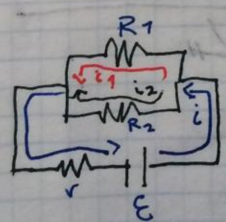
$\varepsilon - iR = 0$

$\varepsilon = iR$

$\varepsilon - iR - ir = 0$

$\varepsilon = iR + ir$

$\varepsilon = i(R + r)$

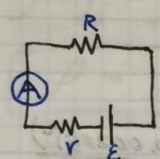


$i = i_1 + i_2$

25...25, 29, 31, 33, 35

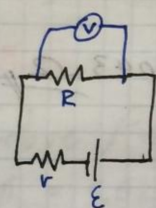
·Amperímetro:

Mide corriente, se conecta en serie



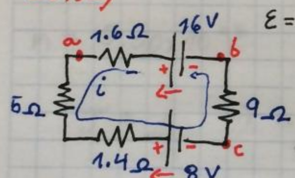
$R_A \to 0$ Para no interferir

·Voltímetro:



$R_V \to \infty$ Para que no afecte

25.32)



$\varepsilon = 16V - 8V = 8V$ ↻ dirección más grande

a) $i = ?$

b) V_{ab}

c) V_{ac}

a) $\varepsilon = i \sum R$

$$i = \frac{8V}{(1.6+5+1.4+9)}$$

$i = 0.471 \text{ Amp}$

"i" va al otro sentido

inversa

$$\boxed{\begin{aligned} V_a - 1.6(-0.471) - 16 &= V_b \\ V_a - 15.2 &= V_b \end{aligned}}$$

b) $V_b + \overset{V}{16V} - \overset{iR}{(0.471)(1.60)} = V_a$

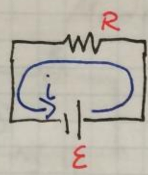
$V_b + 15.2 = V_a \Rightarrow V_a - V_b = 15.2\, V$

c) $V_a - 1.6(-0.471) - 16 - 9(-0.471) = V_c$

$V_a - 11.0 = V_c \Rightarrow V_a - V_c = 11.0 V$

↳ $= V_a - 5(0.471) - 1.4(0.471) - 8 = V_c$

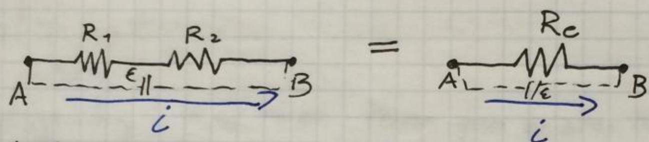
Circuitos de Corriente Directa



$R = \frac{V}{i}$

Conexiones en serie y paralelo

Resistencia en Serie

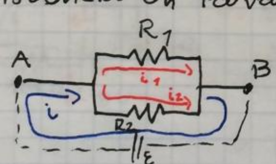


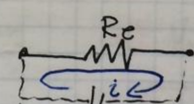
Caída de Potencial

$\hookrightarrow V_e = V_1 + V_2 \Rightarrow i R_e = i R_1 + i R_2$

$\Rightarrow \boxed{R_e = R_1 + R_2}$ En serie

Resistencia en Paralelo





$i_e = i_1 + i_2$

$V = V = V$

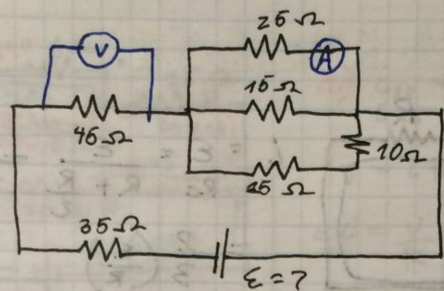
$$\frac{V}{R_e} = \frac{V}{R_1} + \frac{V}{R_2}$$

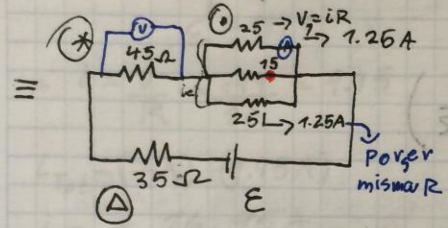
$$\hookrightarrow \boxed{\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2}}$$

$$\hookrightarrow \frac{1}{R_e} = \sum_{i=1}^{n} \frac{1}{R_i}$$

26... Resúmen

26.6)





$V_1 = iR = (1.25)(25) = 31.25\text{ V}$

↳ En todas las que están en paralelo

$i = \frac{V}{R} = \frac{31.25}{15} = 2.08\text{ Amp}$

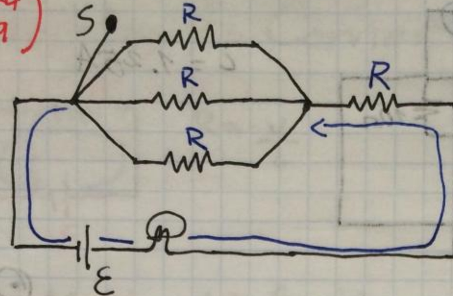
$i_e = 1.25 + 1.25 + 2.08 = 4.58\text{ Amp}$

(*) $V = iR = (4.58)(45) = 206.25\text{ V}$

(Δ) $V = iR = (4.58)(35) = 160.3$

$\varepsilon = 31.25 + 206.25 + 160.3 = 397.8\text{ V}$

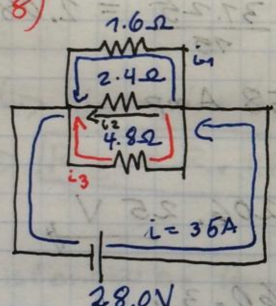
P874) 26.9)



$$i = \frac{\mathcal{E}}{R_e} = \frac{\mathcal{E}}{R + \frac{R}{2}} = \frac{2\mathcal{E}}{3R} = \frac{2}{3}\left(\frac{\mathcal{E}}{R}\right)$$

$$i = \frac{\mathcal{E}}{R_e} = \frac{\mathcal{E}}{R + \frac{R}{3}} = \frac{3}{4}\left(\frac{\mathcal{E}}{R}\right)$$

2.6.8)

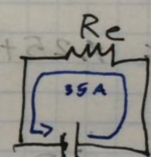


a) $R_e = ?$

b) $i_{c/R} = ?$

c) $i_{Tot} = ?$

≡



Es Mas pequeña que la mas pequeña

$$\frac{1}{R_e} = \frac{1}{1.6} + \frac{1}{2.4} + \frac{1}{4.8} \Rightarrow R_e = 0.800\Omega$$

$$i = \frac{V}{R} = \frac{\mathcal{E}}{R} \Rightarrow i = \frac{28.0V}{0.800\Omega} = 35.0\,A$$

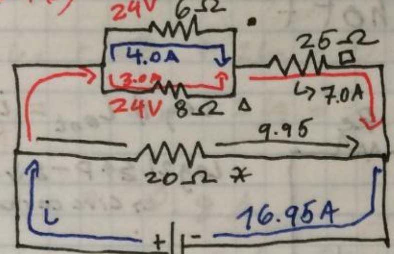
$$i_1 = \frac{\mathcal{E}}{R_1} = \frac{28.0}{1.60} = 17.5 \;;\quad P_1 = V i_1 = (28)(17.5) = 490\,W$$

$$i_2 = \frac{\mathcal{E}}{R_2} = \frac{28.0}{2.4} = 11.67 \;;\quad P_2 = V i_2 = (28)(11.6) = 326.76\,W$$

$$i_3 = \frac{\mathcal{E}}{R_3} = \frac{28.0}{4.8} = 5.83 \;;\quad P_3 = V i_3 = (28)(5.8) = 163.24\,W$$

26... 1, 3, 5, 9, 11, 13

26.16)



$\mathcal{E} = 199V$

$* \quad i = \dfrac{V}{R} = \dfrac{199}{20} = 9.95$

$i_{Tot} = (7A) + (9.95A)$

$i_{Tot} = \underline{16.95A}$ //

a) $i_{20} = ? \quad 9.95\,A$

$i_{25} = ? \quad 7A \rightarrow 4+3$

$\bullet\ V = iR = (4)(6) = 24V$

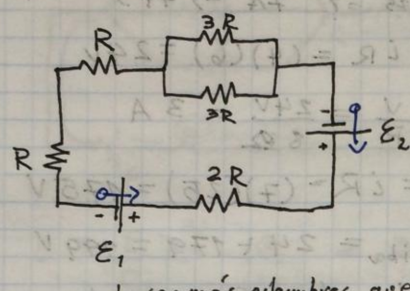
$\Delta\ i = \dfrac{V}{R} = \dfrac{24V}{8\,\Omega} = 3\,A$

$\square\ V = iR = (7)(25) = 175V$

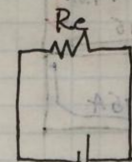
$V_{arriba} = 24 + \overset{iR}{17\cancel{9}} = 199V$

$\therefore V_{enmedio}$ y $\mathcal{E} = 199V$

Leyes de Kirchhoff



$\equiv$



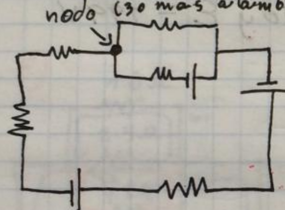
Ley 1) $i_{ent} = i_{sale}$

Ley 2) $\sum \uparrow P - \varepsilon \downarrow P = 0$

↳ Circ cerrado

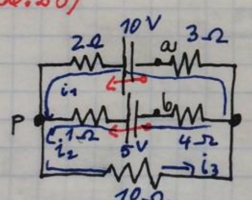
↳ Suponiendo $\varepsilon_1 > \varepsilon_2$

nodo (3 o más alambres que concurran)



Ya no se puede ya que las FEM no están en la misma línea

26.28)



$i_1 + i_2 = i_3$ ①

$i_1 + i_2 - i_3 = 0$

②
$V_p - 10i_3 - 3i_1 + 10 - 2i_1 = V_p$

$10 - 10i_3 - 5i_1 = 0 \Rightarrow i_1 + 2i_3 = 2$

③
$-10i_3 - 4i_2 + 5 - 1i_2 = 0$

$5 - 10i_3 - 5i_2 = 0 \Rightarrow 2i_3 + i_2 = 1$

26... 25, 27, 29

$i_1 + i_2 - i_3 = 0$

$i_1 + \cancel{} + 2i_3 = 0$

$i_2 + 2i_3 = 1$

$$\left.\begin{array}{l} \cancel{i_1} + i_2 - i_3 = 0 \\ -\cancel{i_1} \quad - 2i_3 = 0 \end{array}\right.$$

$\cancel{i_2} - 3i_3 = 2$

$-\cancel{i_2} - 2i_3 = 1$

$\cancel{-5i_3 = 3}$

$i_3 = 0.6$

a)

$i_1 = 0.8\,A$

$i_2 = -0.2\,A \rightarrow$ Otro sentido

$i_3 = 0.6\,A$

b)

$V_b - 4i_2 - 3i_1 = V_a$

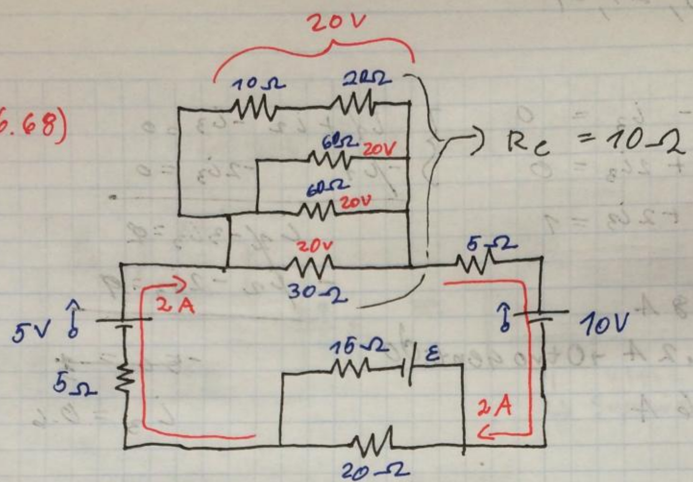
$V_b - 4(0.20) - 3(0.8) = V_a$

$V_b - 0.80 - 2.40 = V_a$

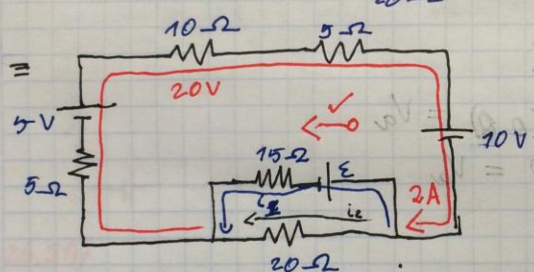
$V_b - V_a = 3.2\,V$ //

26... 33, 61, 63, 65, 66

26.68)



=



→ i_2 sentido correcto

$i_1+i_2=2$

$-\cancel{2}(5+10+5)$ De la parte igual

$-2(20)+5-10-20i_2=0$

$\Rightarrow i_2=-2.25A \quad \therefore i_1=4.25\ A$

$-20(2.25)-\varepsilon-15(4.25)=0$

$\Rightarrow \varepsilon=-108.75V$

b) 60 J t = ?

$10i+20i=20$

$i(10+20)=20$

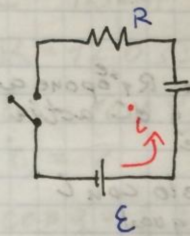
$i=\frac{20}{10+20}=0.67A$

$P=i^2R=(0.667)^2(10)=4.44W$

$P=\frac{W}{\Delta t} \Rightarrow \Delta t=\frac{W}{P}=\frac{60\ J}{4.44\ W}=13.64s$

Circuito abierto capacitor actúa como alambre
Capacitor cargado actúa como alambre cortado

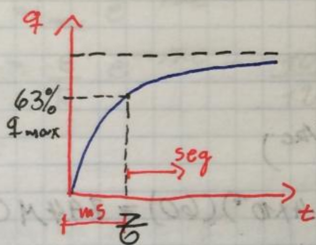
Circuitos RC



$t = 0$
$q = 0$
$i = i_{max} = \frac{\varepsilon}{R}$

$t \to \infty$
$q = C\varepsilon$
$i = 0$

Gráfica característica de un circuito RC



$\tau \Rightarrow$ constante capacitiva de tiempo

magnitud $\langle \tau \rangle = \underset{R}{10^3} * \underset{C}{10^{-6}} = 10^{-3}\, s$
$\approx ms$

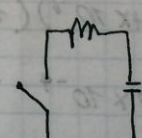
Si dicen tiempo en seg = q_{max}

$\tau = RC$

$q = C\varepsilon(1 - \varepsilon^{-t/RC})$

$e^{-t/RC}$ cuando $t \to \infty = 0$

$i = i_{max}\, e^{-t/RC} \Rightarrow \frac{\varepsilon}{R} e^{-t/RC}$



$q = q_{max}\, e^{-t/RC}$

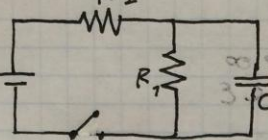
$q_{max} = C\varepsilon$

$i = -\frac{\varepsilon}{R} e^{-t/RC}$ → descarga

(no hay ε)

26... 41, 43, 45

25.83)



En $t=0$

$q=0$

$i=\dfrac{\varepsilon}{R_2}$ → Debido a que R_1 se opone a la corriente y de C actúa como alambre

En $t\to\infty$

i_R → Ya que está en paralelo con C y en paralelo V es igual

$q = CV = C\left(\dfrac{\varepsilon}{R_1+R_2}\right)R_1$

$i = \dfrac{\varepsilon}{R_1+R_2}$

26.42)

$C = 12.4\ \mu F$

$R = 0.895\ M\Omega$

$V = 60.0\ V$

q a→ a) $t = 0.0\ s$

b) $t = 5.0\ s$

c) $t = 10.0\ s$

d) $t = 20.0\ s$

e) $t = 100.0\ s$

a) $q = q_{max}\left(1-e^{-t/RC}\right)$

$q_{max} = C\varepsilon = (12.4\times10^{-6})(60) = 744\ \mu C$

$RC = (0.895\times10^{6})(12.4\times10^{-6}) = 11.1\ s$

$q=0$

b) $q = (744\times10^{-6})\left(1-e^{-5/11.1}\right) = 2.70\times10^{-4}$

c) $q = (744\times10^{-6})\left(1-e^{-10/11.1}\right) = 4.48\times10^{-4}$

d) $= 6.21\times10^{-4}$

e) $= 7.4\cancel{4}\times10^{-4}$

29/9/14

P 878
26.46)

$C = 1.50\mu F$

$R = 12.0\,\Omega$

$\mathcal{E} = 10.0\,V$

$i = ?$

con $q = \frac{1}{4} q_{max}$

$$q = q_{max}(1 - e^{-t/RC})$$

$$0.25 q_{max} = q_{max}(1 - e^{-t/RC})$$

$$0.75 = e^{-t/RC}$$

$$e^{t/RC} = \frac{1}{0.75} \Rightarrow \frac{t}{RC} = \ln\left(\frac{1}{0.75}\right)$$

$$t = RC \ln\left(\frac{1}{0.75}\right) = (12)(1.5\times10^{-6})\ln\left(\frac{1}{0.75}\right)$$

$$t = 5.18\,\mu s$$

$$i = i_{max}\, e^{-t/RC}$$

$$i = \frac{\mathcal{E}}{R} e^{-t/RC} = \frac{10}{12} e^{-(5.18\times10^{-6})/(12)(1.5\times10^{-6})} = 0.625\,A$$

P2